FLORIDA TECH OCEAN ENGINEERING PROFESSOR LEE HARRIS AND HIS GRADUATE STUDENTS ASSIST WITH POST-HURRICANE IVAN CORAL REEF RESTORATION IN THE CAYMAN ISLANDS

Lee E. Harris, Ph.D., P.E.
Assoc. Professor of Ocean Engineering

Doug Bowlus and Ashley Naimaster
Ocean Engineering Graduate Students

Department of Marine and Environmental Systems
Florida Institute of Technology
Melbourne, Florida 32901 USA

September 22-28, 2005

Dr. Lee Harris, Florida Tech associate professor of ocean engineering, and two of his graduate students, Doug Bowlus and Ashley Naimaster, participated as volunteers for a coral reef restoration and coral propagation project on Grand Cayman in the Cayman Islands during September 2005. Grand Cayman suffered severe damages from a direct hit by category 5 Hurricane Ivan in 2004, including some damages to the shallower nearshore reef areas. There were several goals of this project, including:

1. Filming of the project by the BBC for a special television program "Jewels of the Caribbean" to be aired later this year.
2. Demonstrate and teach coral propagation to the staff of the Cayman Islands Department of the Environment (DOE) to help them to be prepared in case there are any future damages to the precious coral reefs in the Cayman Islands.
3. Rescue and propagate local imperiled corals of a variety of target species.
4. Plant propagated corals on the existing Reef Ball artificial reef breakwater units on Grand Cayman.
5. Deploy additional Reef Ball artificial reef units for coral propagation at two new sites.
6. Help rebuild tourism on the Cayman Islands by providing tourists with easily accessible snorkeling coral reefs.

Sponsors and organizers for this project included the Reef Ball Foundation (project organization, supplies, tools, t-shirts, etc.), Dr. Lee Harris (ocean engineering professor at Florida Institute of Technology, providing engineering services and deployment supervision), Grand Cayman Marriott Beach Resort (hotel accommodations and meals), Red Sail Sports (SCUBA equipment and boat support), West Indian Marine Group (ship and diving operations, facility space and coordination of an example casting of a Reef Ball), Cayman Islands Departments of Tourism and Environment (expedited permissions for this project), and many volunteers (personal donations of airfare and expenses by each participant).

Figure 1 shows the BBC photographer filming Dr. Lee Harris as he supervises and assists with the deployment of a Reef Ball artificial reef unit at Cemetery Reef in Grand Cayman. This area

was damaged by Hurricane Ivan, and four new Reef Ball units were deployed in this area as a demonstration for reef restoration. Coral propagation on the Reef Ball units was performed, as shown in Figure 2.

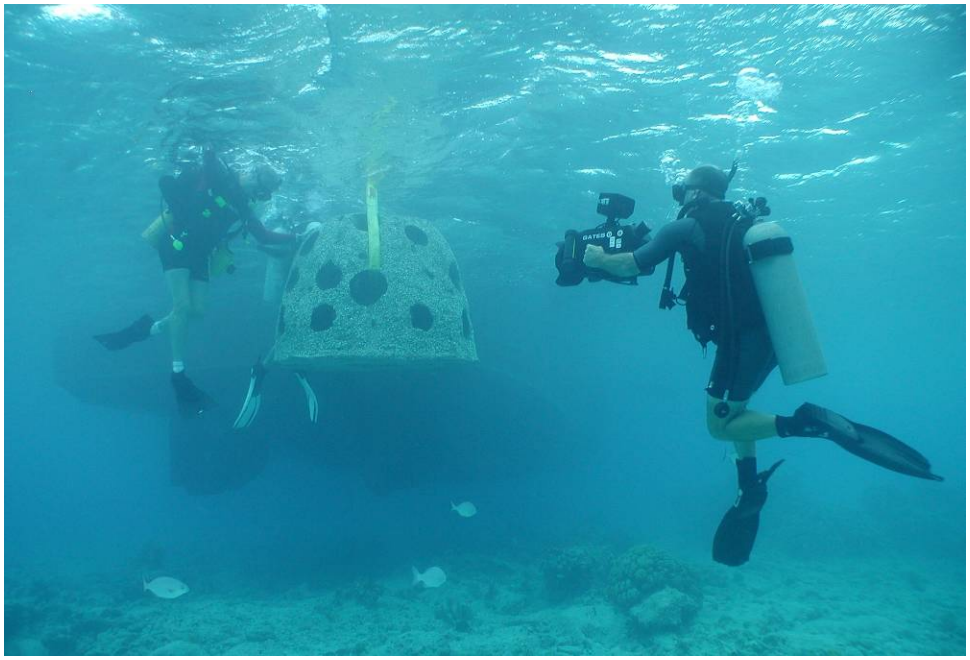

Figure 1. Dr. Lee Harris (on left) assisting with Reef Ball deployment (BBC videographer on the right).

Figure 2. Reef Ball Foundation Volunteers planting Corals on Reef Ball Units.

Fabrication of Reef Ball units was also performed for BBC filming. Figure 3 shows Florida Tech ocean engineering graduate students Ashley Naimaster and Doug Bowlus assembling a Reef Ball mold.

Figure 3. Reef Ball Mold Assembly by Ashley Naimaster (left) and Doug Bowlus (right).

Background Information

Initial field inspections were first performed by Dr. Harris in February 2002 to investigate the beach erosion problems at the southern end of Seven Mile Beach on Grand Cayman Island, and to determine alternatives for restoring and stabilizing the beaches. An array of alternatives was considered, and a submerged breakwater constructed of 200 Reef Ball™ artificial reef units was chosen. Design and permitting of the project was performed during the winter and spring of 2002, with fabrication of the units and deployment offshore performed in the summer and fall of 2002. The project was completed in November 2002, and successfully survived the direct hit of Grand Cayman by Category 5 Hurricane Ivan in the fall of 2004.

An aerial photograph of the submerged breakwater located offshore of the Grand Cayman Marriott Beach Resort is shown in Figure 1. Above water and underwater photographs are shown in Figure 2. The purpose of this system is to assist with beach and shoreline stabilization, and the project also provides the additional benefits of environmental enhancement and a snorkeling reef attraction for tourists.

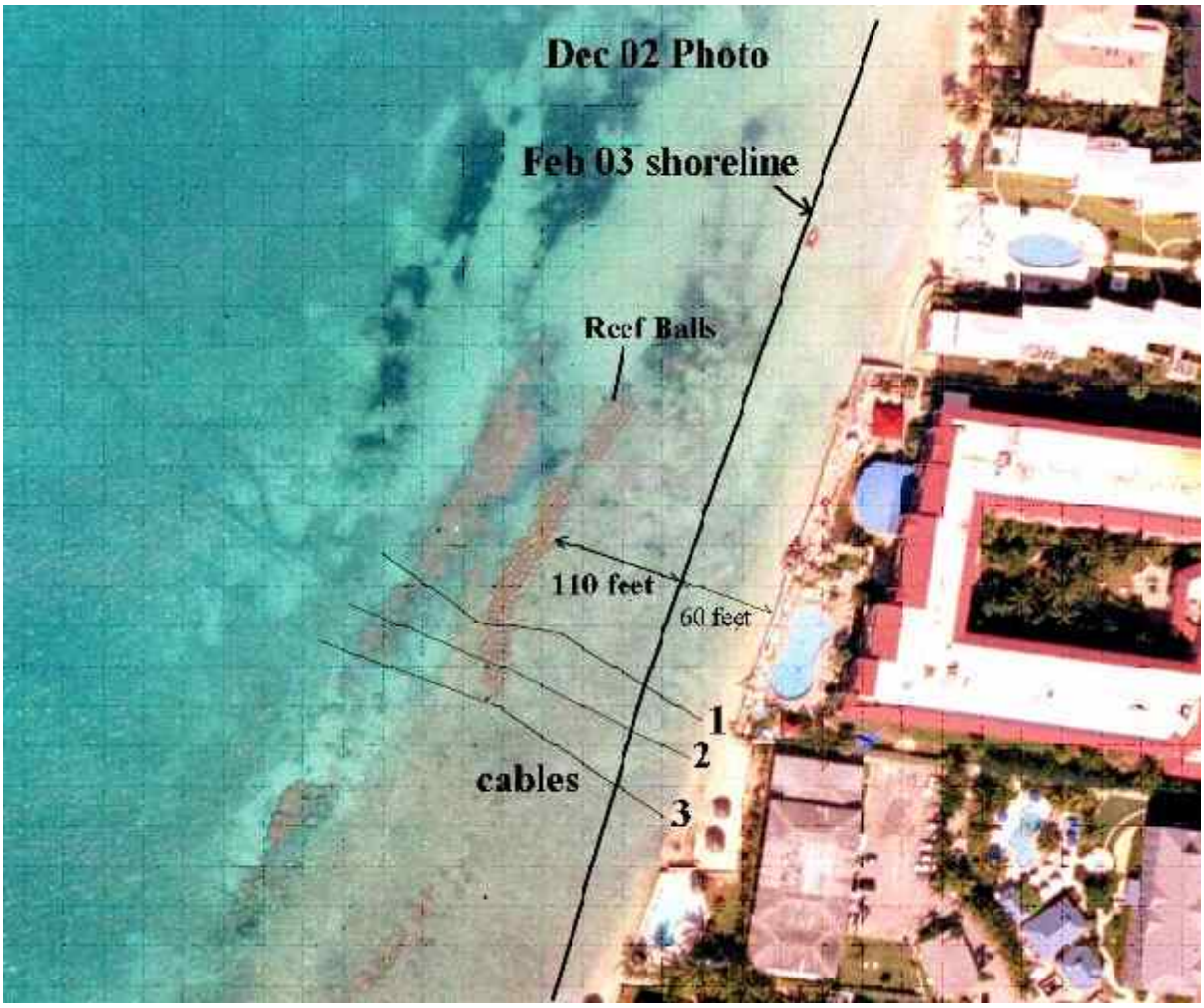

Figure 4. Aerial Photograph of Reef Ball Artificial Reef Submerged Breakwater.

Figure 5. Grand Cayman Marriott Reef Ball Artificial Reef Submerged Breakwater - Above (left) and Underwater (right) Photographs.

Photographs of the beach in October 2002 (prior to completion of the Reef Ball breakwater) and February 2003 (3 months after the completion of the breakwater) are shown in Figures 4 and 5. As shown in these and newer photographs, the Reef Ball breakwater offshore of the Grand Cayman Marriott Beach Resort continues to maintain a wider and more stable beach than before.

Figure 6. Before and After Breakwater Installation Photographs – View South October 2002 (left) and February 2003 (right)

Figure 7. Before and After Breakwater Installation Photographs – View North October 2002 (left) and February 2003 (right)

Artificial Reef Submerged Breakwater Project Design

To stabilize and enhance the beach at the Grand Cayman Marriott Resort, an artificial reef submerged breakwater was installed in the summer and fall of 2002 to reduce the wave action reaching the beach. The recommended design shown in Figure 6 uses 5 rows of Reef Ball^{TM} artificial reef units to provide a 30-foot wide submerged breakwater. The 3.7 to 4.5 feet high artificial reef breakwater units were installed in low tide water depths of 4 to 5.5 feet, so that the top of the units are slightly below the lowest normal water level (0.3 to 1.8 feet).

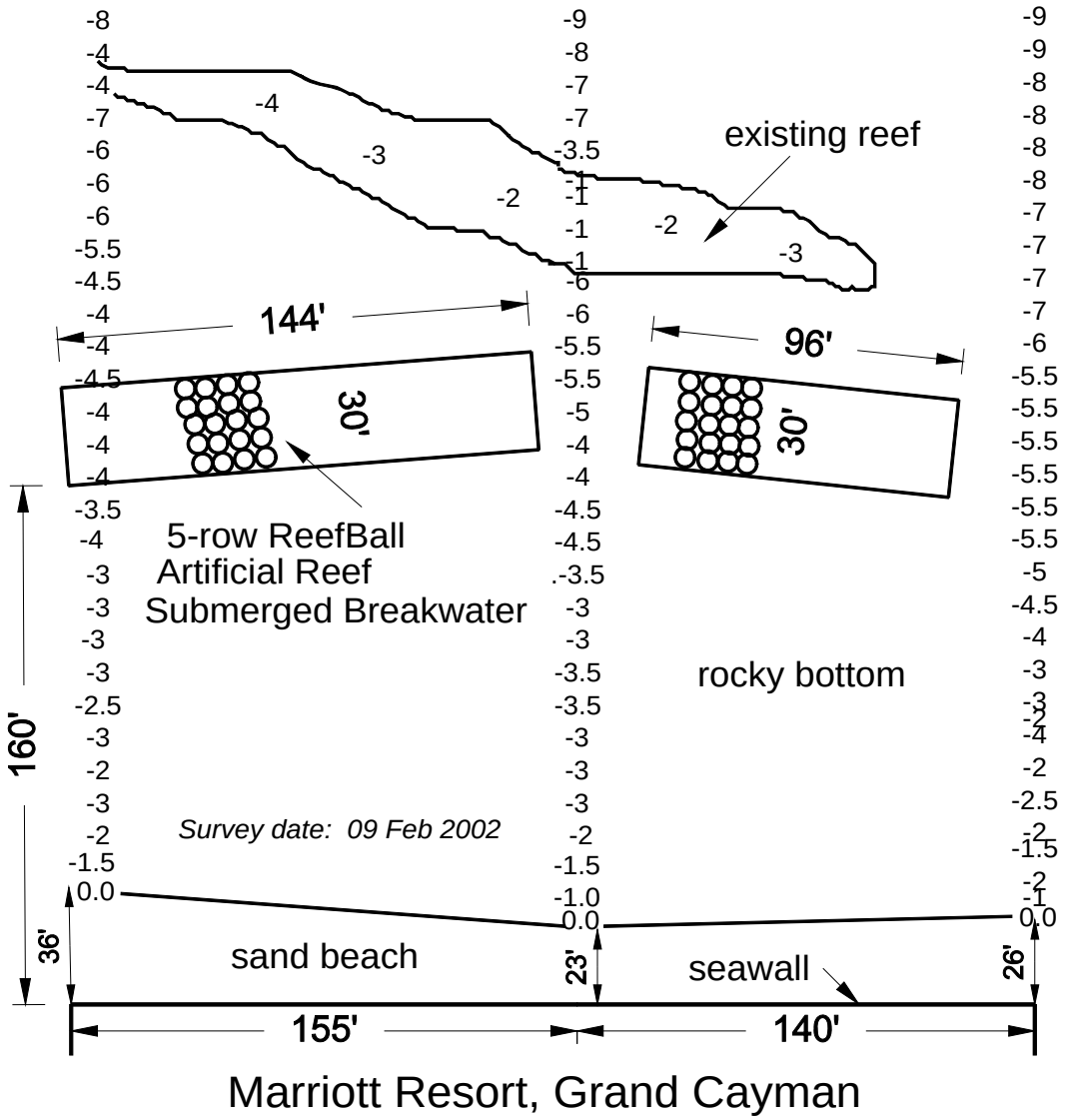

Figure 8. Reef Ball™ Artificial Reef Submerged Breakwater Design

A submerged breakwater reduces the wave action that reaches the beach, thereby assisting to stabilize the shoreline. Unlike traditional breakwaters that project above the water surface and stop all wave action, submerged breakwaters allow the smaller waves to pass over the structure so that sand transport along the coast is maintained during normal conditions. During large wave events, the larger waves are forced to break on the submerged breakwater, thereby reducing the wave energy reaching the beach from large waves and reducing the associated beach erosion.

The submerged Reef Ball artificial reef breakwater has assisted in stabilizing the shoreline by reducing the wave action that impacts and erodes the beach. The use of artificial reef units for a submerged breakwater also provides underwater habitat, enhancing the environment. Many fishes and benthic species inhabit the Reef Balls, including natural coral growth on the units.